rounded joint 47 at the base through which one mechanical linkage can slide linearly and where the base is attached to a fixed surface 48 such that the surface does not prohibitively impede the movement of the device. FIG. 7 shows an embodiment having 3 rotary joints and 3 linear joints, where the basal connection can slide about the base in a two-dimensional plane in the cross configuration 49 on base 51. FIG. 8 shows an embodiment having 5 rotary joints and 3 linear joints, including three-dimensionally rotatable rounded joint 52 at a perpendicular projection from the base 53 through which one mechanical linkage 54 can slide linearly through the joint 52.

A13

Replace the paragraph starting on page 12, line 25, with:

While any of the above discussed configurations or others can be used in accordance with the present invention, FIGS. 9-11 show different mechanisms for providing resistance to the manual manipulation of the stylus by the user. FIG. 9, for example, shows return or tension springs 56 on each joint of the embodiment shown in FIG. 1. In an alternative embodiment, FIG. 10, shows counter-weights 57 on each joint. Moreover, FIG. 11, shows a combination of a return or tension spring 56, a counter-weight 57 and a compression spring 58. The arrangement of the resistance mechanism used should depend upon the configuration stylus mechanical linkage combination, such arrangement preferably chosen to maximize the ease with which the user can manipulate the stylus 11 in free space in accordance with the present invention.

In the Claims:

All pending claims are listed below. Claims which have been changed by this amendment are marked as "amended." No Marked-up version of the claims is provided since all pending claims are new.

Please cancel claims 1-26 without prejudice.

Please add the following claims:

A14

27. (new) A human interface device for enabling manual interactions with application software running on a host computer, said software providing images displayed on a display apparatus, said device comprising:

(a) a user manipulatable physical object physically contacted and moveable by a user, said user manipulating said user manipulatable physical object in a plurality of rotational degrees of freedom with respect to a surface, wherein three of said degrees of freedom closest to said user manipulatable object allow an orientation of said object to be adjusted in three dimensional space while three degrees of freedom closest to said surface allow a location of said object to be adjusted in three dimensional space;

(b) a sensor apparatus coupled to at least one of said user manipulatable physical object and said support mechanism and that produces a locative signal which is responsive to and corresponding with said location and said orientation of said user manipulatable physical object with respect to said surface at points in time during normal operation;

(c) a communication bus coupled to said host computer;

(d) a device microprocessor separate from said host computer and coupled to said host computer by said communication bus, said device microprocessor being coupled to said sensor apparatus, said device microprocessor running a program contained at least in part in a non-volatile memory coupled to said device microprocessor and separate from said host computer, said device microprocessor providing information for use by said host computer running an application program simultaneously with said microprocessor running said program, said information including a representation of said locative signal,

wherein said application program of said host computer can provide images on a computer display, said images updated on said computer display in response to said locative signal, and

wherein said host computer can provide host commands, said host commands being communicated to said device microprocessor by said communication bus, wherein said device microprocessor:

(i) monitors said communication bus for said host commands; and

(ii) decodes said host commands, wherein

at least one of said host commands causes information to be reported from said device microprocessor to said host computer, and

at least one of said host commands causes said device microprocessor to output control signals to cause a force to be output to said user, said at least one host command and said force being correlated with at least one of said images developed by said host computer on said computer display; and

(e) a force generator controlled by said device microprocessor for providing a force to to said user in response to at least one of said control signals.

28. (new) A human interface device as recited in claim 27 further comprising a support mechanism which supports said user manipulatable physical object while allowing said plurality of degrees of freedom in the motion of said user manipulatable physical object.

29. (new) A human interface device as recited in claim 28 wherein said support mechanism includes a linkage coupled between said user manipulatable physical object and said surface.

30. (new) A human interface device as recited in claim 27 wherein said user manipulatable physical object has a pencil-like stylus configuration that can be manually manipulated by a user of said device.

31. (new) A human interface device as recited in claim 27 further comprising a switch coupled to said user manipulatable object, said switch capable of being in multiple states in response to user interaction, wherein a state of said switch being transmitted to said host computer and wherein an action is taken by said host computer in response to said state of said switch.

32. (new) A human interface device as recited in claim 27 further comprising a plurality of command routines stored in said local memory, at least one of said command routines allowing said microprocessor to control said force generator in accordance with at least one of said decoded host commands, and at least one of said command routines reporting a representation of said locative signal to said host computer in accordance with at least one of said decoded host commands.

33. (new) A human interface device as recited in claim 27 wherein said device microprocessor computes the position or orientation of said user manipulatable object from said locative signal produced by said sensor apparatus, said microprocessor reporting said position or orientation to said host computer.

34. (new) A human interface device as recited in claim 27 wherein said device microprocessor executes a routine stored in a non-volatile memory accessible by said device microprocessor and based on said host command, wherein said routine processes said locative signal into angle data, and wherein said angle data is sent to said host computer.

35. (new) A human interface device as recited in claim 27 wherein said force generator transmits a force via said support mechanism in response to said force signals, and

wherein said force signals are correlated to information displayed on said computer display apparatus, said information including a cursor interacting with a graphical surface.

36. (new) A human interface device as recited in claim 27 wherein at least one of said host commands calls a subroutine stored on said microprocessor to change a resistance at a joint of said support mechanism.

37. (new) A human interface device as recited in claim 27 wherein forces commanded by said host computer to said device microprocessor and felt by said user correspond to images displayed on said computer display, wherein said images include a cursor interacting with another object displayed on said display screen, wherein said cursor interacts with a surface image displayed on said display screen.

38. (new) An interface device for use in conjunction with a host computer, wherein images are displayed on a computer display apparatus coupled to said host computer, said interface device comprising:

a user manipulatable object engaged by a user's hand to allow dexterous manipulations by fingers of said user;

a mechanical linkage coupled to a fixed surface by a base rotary joint and coupled to said user manipulatable object by an object rotary joint, said linkage for supporting said object allowing at least five degrees of freedom in motion of said object with respect to said fixed surface, wherein said mechanical linkage provides said degrees of freedom through a structure of substantially rigid members joined by a plurality of rotary joints, said mechanical linkage providing said user the ability to manipulate both the location and orientation of said object in three dimensional space, and wherein a configuration of said degrees of freedom allow said user to rotate said object about a fixed point in space when three degrees of freedom closest to said fixed surface are held fixed and when remaining ones of said degrees of freedom are moved;

one or more sensors for producing an interactive object locative signal which is responsive to and corresponding with the position and orientation of the user manipulatable object, said object locative signal providing information about the location and angle of said user manipulatable object for use by said host computer to manipulate images displayed by said computer display apparatus in accordance with said location and angle of said user manipulatable object, said images including a cursor whose position and orientation on said computer display apparatus is influenced by said user manipulatable object locative signal; and

a force generator for generating a force on said user object in at least one of said five degrees of freedom in response to force signals provided to said interactive device, said force signals correlated to information displayed on said computer display apparatus including interaction of said cursor with other images on said computer display apparatus.

39. (new) An interface device as recited in claim 38 wherein said linkage allows six degrees of freedom in motion of said object, wherein three of said degrees of freedom closest to said user manipulatable object allow an orientation of said object to be adjusted in three dimensional space while three degrees of freedom closest to said fixed surface allow a location of said object to be adjusted in three dimensional space.

40. (new) An interface device as recited in claim 38 wherein a configuration of said joints allows said user manipulatable object to spin freely about an axis extending through the length of said object while all others of said joints remain fixed in position.

41. (new) An interface device as recited in claim 38 wherein said user manipulatable object is a stylus having a pen-like configuration to allow writing-like manipulations between said fingers.

42. (new) An interface device for use in conjunction with a host computer and a fixed surface, said device comprising:

a user manipulatable object moveable by a user;

a mechanical linkage coupled to said fixed surface by a base rotary joint and coupled to said user manipulatable object by an object rotary joint, said mechanical linkage allowing at least five degrees of freedom in the motion of said object with respect to said fixed surface, wherein said mechanical linkage provides said degrees of freedom through a structure of substantially rigid members joined by a plurality of rotary joints, said mechanical linkage providing said user the ability to manipulate both a location and an orientation of said object in three dimensional space;

at least one sensor for producing a locative signal which is responsive to a position and orientation of said user manipulatable object, said locative signal providing information about the position and orientation of said user manipulatable object for use by said host computer;

at least one force generator for applying a force to a corresponding rotary joint of said mechanical linkage in response to force signals provided to said position sensing device from said host computer, wherein images are displayed on a computer display apparatus coupled to

said host computer, and wherein said force signals are correlated to information displayed on said computer display apparatus; and

a device microprocessor that receives said force signals from said host computer and provides said force signals to said force generator.

43. (new) An interface device as recited in claim 42 wherein said device microprocessor receives said locative signal from said at least one sensor and outputs a signal based on said locative signal to said host computer.

44. (new) An interface device as recited in claim 42 wherein one of said images displayed by said computer display apparatus is manipulated in accordance with said location of said user manipulatable object, said manipulated image including a cursor having a position on said computer display apparatus influenced by said locative signal.

45. (new) An interface device as recited in claim 42 wherein a configuration of said degrees of freedom allow said user to rotate said object about a fixed point in space when three degrees of freedom closest to said fixed surface are held fixed and when remaining degrees of freedom are moved.

46. (new) An interface device as recited in claim 42 wherein said linkage allows six degrees of freedom in motion of said object, wherein three of said degrees of freedom closest to said user manipulatable object allow an orientation of said object to be adjusted in three dimensional space while three degrees of freedom closest to said fixed surface allow a location of said object to be adjusted in three dimensional space.

47. (new) An interface device for use in conjunction with a host computer, images displayed on a computer display screen, and a fixed surface, comprising:

a stylus having a pencil-like configuration to allow writing-like manipulations between fingers of a user;

a mechanical linkage coupled to a fixed surface and coupled to said stylus for supporting said stylus while allowing at least five degrees of freedom in the motion of said stylus, said mechanical linkage providing a user the ability to manipulate both the orientation and location of said stylus in three-dimensional space;

a sensor for producing an interactive stylus locative signal which provides information about the position and orientation of said stylus for use by said host computer and said computer display screen to manipulate images displayed by said computer display screen in accordance with said orientation, location, or movement of said stylus, said images including a cursor whose position on said computer display screen is controlled by said stylus locative signal; and

a force generator for generating a force on said stylus in at least one of said five degrees of freedom in response to force signals provided to said interactive device, said force signals correlated to information displayed on said computer display screen.

48. (new) A device as recited in claim 47 wherein said mechanical linkage includes at least five joints, wherein a configuration of said joints allows said stylus to spin freely about an axis extending through the length of said stylus while all of said other joints remain fixed in position, and a sensor for sensing said spin and providing a signal describing said spin to said host computer.

49. (new) A device as recited in claim 47 wherein three joints of said mechanical linkage closest to said stylus control said orientation of said stylus, said orientation being variable by a user while a position of a point on said stylus remains fixed.

50. (new) A device as recited in claim 47 further comprising a local memory and a device microprocessor decoding host commands received from said host computer, wherein a plurality of command routines are stored in said local memory, at least one of said command routines allowing said device microprocessor to control said force generator in accordance with at least one of said decoded host commands, and at least one of said command routines reporting a representation of said locative signal to said host computer in accordance with at least one of said decoded host commands.

51. (new) A method for interactively interfacing a user and a computer, the method comprising:

providing a stylus having a pencil-like configuration that allows writing-like manipulations between fingers of said user, said stylus coupled to a mechanical linkage coupled to a fixed surface for supporting said stylus while allowing at least five degrees of freedom in the motion of said stylus, said mechanical linkage for providing a user the ability to manipulate the orientation and location of said stylus in three-dimensional space;

producing an interactive stylus locative signal which is responsive to and corresponding with the position and movement of the stylus at any point in time during its normal operation, said stylus locative signal providing information about the orientation and location of said stylus;

causing a cursor to be displayed by said computer, said computer using said stylus locative signal to position and move said cursor in accordance with the location, orientation, or movement of said stylus; and

providing a force generator operative to generate force on said stylus in at least one of said degrees of freedom in response to force signals provided by said computer to said mechanical linkage, said force signals correlated to information displayed by said computer.

52. (new) A method as recited in claim 51 wherein said mechanical linkage provides said stylus with six degrees of freedom.

53. (new) A method as recited in claim 51 wherein said feedback means generates a force on said stylus by generating a force on a joint included in said mechanical linkage in response to said force signals.

54. (new) A method as recited in claim 51 wherein when said cursor displayed by said computer moves into a different image displayed by said computer, a force signal is output and a force is generated by said force generator in at least one of said plurality of degrees of freedom.